

STUDIES ON AUSTRALIAN MARINE ALGAE. V.

OBSERVATIONS ON AND GEOGRAPHICAL RECORDS OF VARIOUS SPECIES, PARTICULARLY
THOSE OF THE GELIDIUM COMPLEX.

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INTRODUCTION.

This paper is concerned mainly with species of the genus *Gelidium*, various observations and new records of distribution being reported. In addition, extended geographical ranges are recorded for certain other algae and the occurrence of tetrasporic material is noted in a species normally found only in a sterile condition.

Brief mention of certain of these species was made in Notes and Exhibits on an Excursion to the Great Barrier Reef (Anon., 1948).

Unless stated otherwise, the specimens discussed are located either in my own herbarium (quoted as VM), in the National Herbarium of New South Wales, Sydney (quoted as NSW), in the Herbarium of A. H. S. Lucas, now held at the National Herbarium of New South Wales (quoted as AHSL) or in the Herbarium of the University of Sydney, New South Wales (quoted as SYD).

GELIDIUM CAULACANTHEUM J. Ag.

New Record for Australia.

For establishing the specific identity of this species the writer has examined New Zealand material of *G. caulacanthum*, e.g., Lindauer's Alg. N.Z. Exsicc. No. 63 (Herb. VM) and also a series of specimens kindly sent me by Miss L. Moore of D.S. & I.R., Botany Department, Wellington, N.Z.

G. caulacanthum approaches *G. pusillum* (discussed elsewhere in this paper), both species being relatively small tufted plants, dark in colour, often with terete branches pinnately branched. However, *G. caulacanthum* is a larger, more lax plant, with branching less imbricate, and more regularly pinnate, the branching frequently being relatively less developed at the base of the frond. *G. caulacanthum* is nearly terete and shows less tendency to flattening than does *G. pusillum*. So far in Australia *G. caulacanthum* has been found only in harbour or estuarine waters, whereas *G. pusillum* frequents headlands exposed to the ocean and occurs less frequently in sheltered waters; however, both species have been found growing associated (at Bradley's Head, Port Jackson, N.S.W., 20/1/1946; specimens both quoted this paper).

Localities from which *G. caulacanthum* has been collected in Australia are as follows:

Locality.	Date.	Herbarium.	Notes.
Port Jackson, N.S.W.— Bradley's Head.	20/ 1/1946	V.M. No. 1196.	Both tetrasporic and cystocarpic plants.
		No. 2002-4. No. 2006.	
" "	23/ 6/1947	V.M. No. 2343-4. No. 2345-8.	Cystocarpic plants.
Mrs. Macquarie's Chair, Botanic Gardens.	28/11/1947	V.M. No. 2474-5.	
Rose Bay.	28/11/1947	V.M. No. 2476.	
Woolloomooloo Bay.	-/11/1931	A.H.S.L.	Both tetrasporic and cystocarpic plants.
Clifton Gardens.	-/ 1/1914	A.H.S.L.	
Farm Cove.	-/ 4/1930	A.H.S.L.	

* Contribution No. 79 from the laboratory.

OBSERVATIONS ON *GELIDIUM AUSTRALE* J. Ag.

For authentic material of this species I have examined Harvey's Alg. Aus. Exsicc. No. 333H *Gelidium asperum* (specimen in Herb. NSW) from Western Point, Victoria, which A. and E. S. Gepp (1906) record as being true *G. australe* J. Ag.

This and other specimens of the species show rhizoidal filaments abundant, originating first in the cortical region of the thallus. These observations do not accord with Okamura's report (1934, p. 55) that an Australian specimen of *G. australe* was "void of rhizoidal filaments".

G. australe has been recorded in Australia as *G. asperum* by Harvey, among others (as quoted above). I have not seen authentic material of *G. asperum* from Australia, nor apparently has Lucas (1931). Dr. Tore Levring (private correspondence) has agreed that the *G. asperum* recorded by him (1946) from Victoria, Australia, is in fact *G. australe*. He says that the limits between these two species "do not seem to be very sharp".

G. australe is known from the southern coasts of Australia, from Tasmania and from New South Wales; I have also found it as drift in southern Queensland. In habit the species resembles a fine form of *Pterocladia capillacea*. Lucas (1914) surprisingly recorded the species as "characteristic of the ocean surf-flora", but in 1935 he recorded it from Botany Bay and Port Jackson, i.e., estuarine waters of New South Wales. The latter record is in accord with the present writer's experience that *G. australe* frequents sheltered waters of harbours and estuaries such as Botany Bay, Port Jackson and Pittwater in New South Wales.

GELIDIUM CRINALE J. Ag.

Species excluded from Australian Records.

This species was recorded from Queensland, Australia, by A. D. Cotton (1915). In answer to a request for Queensland material of this species, Miss C. I. Dickenson, of the Herbarium, Royal Botanic Gardens, Kew, kindly sent me a specimen labelled *G. crinale*, and collected by A. J. Banfield, in February, 1910, at Dunk Island, off Queensland. This is likely to be a portion of the material on which Cotton based his record. This specimen is not *G. crinale*; it lacks both the rhizoidal filaments and apical cell which are characteristic of the genus *Gelidium*. The specimen quoted is, in fact, *Gelidiopsis intricata* (Ag.) Vickers, a species discussed elsewhere in the present paper. The writer therefore rejects the record of *Gelidium crinale* from Australia.

NOTE ON THE ANATOMY OF *GELIDIUM LUCASII* May.

In 1944 I described and figured portions of the thallus of this species and inadvertently used the term "filament" in a different sense from that usually used in this genus. The structures I figured occur very much nearer to the apices than do the true rhizoidal filaments (sensu Okamura, 1934). Sections taken further from the apex of *G. Lucasii* show that the true rhizoidal filaments originate in the peripheral layers outside a zone of large cortical cells. Lower down the axis rhizoidal filaments occur in the medulla also. Thus *G. Lucasii* follows Okamura's rule that generally a cross section of the thallus of a species of *Gelidium* shows rhizoidal filaments very evident towards the periphery of the thallus.

GELIDIUM PUSILLUM (Stackh.) Le Jol.

Variation and Distribution.

Bailey (1912) recorded this species from Queensland on the authority of identification made from Kew, presumably by Mr. A. D. Cotton; since then the species has been quoted as known from Australia, or North Australia, without more detail as to location. Lucas (1934) referred to a species "recalling in habit *G. pusillum* (Stackh.) Le Jol." from Low Island, Qsld., but generally there appears to be extremely little information in the literature about *G. pusillum* and where and in what forms it occurs in Australia.

G. pusillum is a persistent element in our marine flora and is now recorded from a number of localities in N.S.W., S.A., W.A., Tas., and also from Lord Howe Island.*

The identification of this species is based primarily on the description and illustration of Okamura (1934) and also on comparison with Lindauer's Alg. N.Z. Exsiccatae No. 238 (Herb. VM).

Of the species of *Gelidium* previously recorded from Australia, *G. pusillum* is fairly readily recognized by its small size, felting base and compact habit. The distinctions between *G. pusillum* and *G. caulacanthum* are discussed in this paper under the latter species.

The Australian specimens of *G. pusillum* vary greatly, but withal the series shows continuous gradations with frequent transition stages between forms, so that the whole series must be regarded as a single biological unit or species. Given only examples of the extreme forms, one would justifiably consider them as distinct species, but as an examination of a larger range of specimens shows there is no discontinuity, the variation must be regarded as of sub-specific significance only.

At one extreme of this range the specimens are fine and terete, while branching is distant, irregularly alternate or secund. This form is usually found in still waters associated with mud, but may occur in other locations. This is *f. pseudointricata*, discussed below.

With more robust specimens branching is more frequent and more generally pinnate, and branches are more generally flattened. This is the form usually found on ocean headlands and is that usually accepted as alone representing *G. pusillum* (includes var. *conchicola* Picc. and Grun.).

At the other end of the range of *G. pusillum* specimens become very coarse and much flattened, and the branches may become foliose (includes *f. foliaceum* Okam.).

The fine terete form of *G. pusillum* approaches in habit very near to *Geliodiopsis intricata* (Ag.) Vickers (= *Gelidium intricatum* Kuetz.), from which it differs anatomically (*Geliodiopsis* having no apical cell or rhizoidal filaments). The description and illustrations (Levring, 1941) of *Gelidium pseudointricata* Skotts. and Levr. suggest that this species represents merely the fine form of *G. pusillum*. Examination of Lindauer's specimen of *G. pseudointricata* (Alg. N.Z. Exsicc. No. 263, Herb. NSW) confirms this opinion, and *G. pseudointricata* Skotts. and Levr. is consequently now reduced in status from species to form, becoming *G. pusillum f. pseudointricata* (Skotts. and Levr.), stat. nov.

Gelidium crinale (Turn.) Lamx. is reported as also very near in habit to *Geliodiopsis intricata*; it appears to be closely allied to *G. pusillum f. pseudointricata* and may actually be identical. I have insufficient material available for determining this point.

In the following list of Australian collections of *G. pusillum* the specimens are arranged according to their form, ranging from finest to coarsest, but it must be emphasized that there are no distinct breaks between these various forms; rather the species consists of a series of intergrading forms.

Locality.	Date.	Herbarium.	Notes.
<i>f. pseudointricata</i> —			
Sans Souci, Botany Bay, N.S.W.	11/ 3/1945	V.M. No. 555.	Tetrasporic.
Tuggerah, N.S.W.	10/ 2/1943	V.M. No. 699.	Cystocarpic. On whelks.
Queen's Lake, Laurieton, N.S.W.	30/ 4/1944	V.M. No. 1146.	Cystocarpic. On whelk.
Rose Bay, Port Jackson, N.S.W.	28/11/1947	V.M. No. 2478.	Shows range of form.
Lord Howe Island.	-/ 5/1932	A.H.S.L.	Tetrasporic. Coll. F. A. McNeill.
Pennington Bay, Kangaroo Is., S.A.	16/ 1/1945	V.M. No. 909.	Tetrasporic.
Gladsville Bay, Parramatta, N.S.W.	-/11/1930	A.H.S.L.	Tetrasporic. Coll. A. H. S. Lucas.
Narrabeen Head, nr. Sydney, N.S.W.	6/ 5/1945	V.M. No. 744.	Tetrasporic.
Fairy Bower, Manly, nr. Sydney, N.S.W.	28/ 4/1945	V.M. No. 704.	

* Specimens from Kangaroo Island, South Australia, quoted in this paper, were sent to the writer for identification by H. B. S. Womersley, who has since recorded the occurrence of this species in his ecological studies (*Trans. Roy. Soc. S. Aus.*, 71 (2) : 1947. 228-252, Pls. 9-13).

Locality.	Date.	Herbarium.	Notes.
Whale Beach, nr. Sydney, N.S.W.	22/ 6/1947	V.M. No. 2341.	Tetrasporic.
Kangaroo Island, S.A.	—	V.M. No. 910.	Shows variation.
Encounter Bay, S.A.	—	A.H.S.L.	Coll. J. B. Cleland.
Lane Cove River, Port Jackson, N.S.W.	13/ 5/1945	V.M. No. 756.	Mangrove Swamp. On whelk. Plants taller than usual for this form.
Barrenjoe Head, Palm Beach, nr. Sydney, N.S.W.	25/ 2/1945	V.M. No. 516.	Collection shows variation. Plants taller than usual for this form. Sheet B, tetrasporic.
Cottesloe, Swan River, W.A.	-/10/1926	A.H.S.L.	Tetrasporic. Coll. I Banks.
" " "	-/12/1926	A.H.S.L.	Coll. I Banks.
<i>var. conchicola</i> —			
Sandy Bay, R. Derwent, Tas.	-/ 1/1909	A.H.S.L.	Tetrasporic. Coll. L. Rodway.
Snug, Tas.	-/11/1925	A.H.S.L.	Coll. A. H. S. Lucas.
Long Reef, nr. Sydney, N.S.W.	3/ 7/1947	V.M. No. 2362.	This collection shows a good range of form.
Balmoral, Port Jackson, N.S.W.	4/ 9/1947	V.M. No. 2411.	
Narrabeen Headland, nr. Sydney, N.S.W.	6/12/1947	V.M. No. 2482.	
Kurnell, Botany Bay, N.S.W.	16/11/1944	V.M. No. 195.	Tetrasporic.
Newport, nr. Sydney, N.S.W.	21/10/1944	V.M. Nos. 491, 492.	"
Collaroy, nr. Sydney, N.S.W.	11/11/1944	V.M. No. 489.	"
Bradley's Head, Port Jackson, N.S.W.	20/ 1/1946	V.M. No. 2005.	"
Forty Baskets, nr. Manly, Port Jackson, N.S.W.	17/11/1945	V.M. No. 1056.	
Careel Head, Whale Beach, nr. Sydney, N.S.W.	1/ 1/1946	V.M. No. 1186.	
Newport Headland, nr. Sydney, N.S.W.	-/ 4/1945	V.M. No. 707.	Tetrasporic.
Sans Souci, Botany Bay, N.S.W.	5/ 5/1946	V.M. No. 2076.	
Fairy Bower, Manly, nr. Sydney, N.S.W.	31/ 8/1947	V.M. No. 2407.	
Bondi, N.S.W.	-/4/1914	A.H.S.L. and N.S.W.	Tetrasporic. Coll. A. H. S. Lucas.
Little Coogee, N.S.W.	-/ 2/1914	A.H.S.L.	
Forms approaching <i>f. foliaceum</i> —			
Port Hacking, Port Macquarie, N.S.W.	31/ 5/1937	V.M. No. 2318.	Tetrasporic.
Potato Point, nr. Tuross Lake, Sth. Coast, N.S.W.	26/10/1947	V.M. No. 2465.	
Green Island, nr. Entrance of Conjola Lake, Sth. Coast, N.S.W.	3/ 5/1946	V.M. No. 2065.	Tetrasporic.
Stanwell Park, Sth. Coast, N.S.W.	26/ 3/1945	V.M. No. 667.	"
Kiama, Sth. Coast, N.S.W.	23/ 6/1945	V.M. No. 828.	"
Bundeena, Port Hacking, N.S.W.	24/ 6/1945	V.M. No. 834.	Tetrasporic. Plant tall.
Narrabeen Head, nr. Sydney, N.S.W.	1/ 7/1946	V.M. No. 2101.	Cystocarpic. On mussels.
Fairy Bower, Manly, nr. Sydney, N.S.W.	28/ 4/1945	V.M. No. 706.	Tetrasporic. Range of form within this collection.
<i>f. foliaceum</i> —			
North Head, Curl Curl, nr. Sydney, N.S.W.	23/ 2/1948	V.M. No. 2577.	Tetrasporic.

CAULERPA ANCEPS HARV.

New Record for Australia.

Weber Van Bosse (1898) described this species clearly, and my specimens accord with Harvey's Friendly Island Algae No. 67 (Herb. NSW).

C. anceps varies greatly in size of plant and also in whether the edges of the leaves are smooth or dentate. Of Australian species of *Caulerpa*, this species approaches nearest to *C. parvifolia* Harv., from which it differs by being larger and having a very much coarser stolon.

Although collected here some time ago, *C. anceps* has not previously been recorded from Australia.

Locality.	Date.	Herbarium.	Notes.
Heron Island, Great Barrier Reef, Qsld.	-/ 1/1948	V.M. and SYD.	Collected by Sydney University Biological Society. Specimens Nos. 35 and 35X.
Brown Bay, Cairns, Qsld.	-/8/1935	A.H.S.L.	Coll. H. Flecker. Stolon less coarse than usual.
Hayman Is., Great Barrier Reef, Qsld.	-/6/1934	A.H.S.L.	Coll. F. A. McNeill.
Archer Pt., 9 m. North of Cooktown, Qsld.	-/9/1935	A.H.S.L.	Coll. P. Kelly. Stolon less coarse than usual.

SARCONEMA FILIFORME (Sond.) Kylin.

New Record for New South Wales and for Lord Howe Island.

S. filiforme is known from W. and N.E. Australia and from Tasmania, so that it is not surprising that it should occur also in New South Wales.

Locality.	Date.	Herbarium.	Notes.
Double Bay, Port Jackson, N.S.W.	30/7/1943	V.M. No. 2604, 2605.	Trawled.
Bradley's Head, Port Jackson, N.S.W.	-/4/1918	A.H.S.L.	Coll. Hindmarsh.
Lord Howe Island.	-/6/1933	A.H.S.L.	Coll. F. Perrin and A. H. S. Lucas

GELIDIOPSIS INTRICATA (Ag.) Vickers.

Definite Records from Australia.

Specimens of the genus *Gelidiopsis* frequently resemble closely specimens of the genus *Gelidium*, but, following Feldmann (1931), the genera may be readily distinguished, since *Gelidiopsis* lacks an apical cell and does not develop rhizoidal filaments.

Gelidiopsis intricata is a fine terete tufted plant with irregular branching; in habit the species recalls strongly both *Gelidium crinale* (Turn.) Lamour, and *Gelidium pusillum* f. *pseudointricatum* (Skotts. and Levr.) May, as discussed elsewhere in this paper.

Gelidiopsis intricata (as *Gelidium intricatum* Kuetz.) was recorded from "North Australia", without further locality, by Grunow (1874) and there appears to be no more definite locality record of the species from this country, later writers merely repeating the statement that the species had been recorded from Australia. It appears to be of value, therefore, to list the Australian specimens of *G. intricata* which I have examined, and the locations from which these plants were collected.

Locality.	Date.	Herbarium.	Notes.
Low Is., N. Qsld.	-/6/1931	A.H.S.L.	Filed as <i>Gelidium</i> sp.
Green Is., off Cairns, N. Qsld.	-/6/1931	A.H.S.L.	Filed as <i>Gelidium</i> sp.
Dunk Is., Qsld.	-/2/1910	V.M. ex KEW.	Specimen discussed in this paper under " <i>Gelidium crinale</i> ".
Heron Is., Great Barrier Reef, Qsld.	-/1/1948	V.M.	Coll. by Sydney Univ. Biological Society. Specimens No. B1 and B4.
Mooloolaba, Qsld.	24/1/1944	V.M. No. 2602	Drift.
Yorkey's Knob, Qsld.	5/7/1936	V.M. and N.Q. Nats.* No. 2002.	

SYMPHYOCLADIA MARCHANTIOIDES (Harv.) Falk.

New Record for New South Wales.

This species was described and illustrated by Falkenberg (1901) and by Okamura (1912). It has been recorded previously as occurring in north-eastern Australia, but unfortunately none of these specimens is available to me for study.

The present is the first record of *S. marchantioides* from New South Wales; all specimens were encrusting and obtainable only at very low tide. My plants are smaller than, but otherwise agree with, Lindauer's Alg. N.Z. Exsicc. No. 200 (Herb. VM).

Locality.	Date.	Herbarium.	Notes.
Balmoral, Port Jackson, N.S.W.	4/9/1947	V.M. No. 2409, 2410.	Tetrasporic.
Bungan Island, Bungan Head, nr. Sydney, N.S.W.	27/1/1948	V.M. No. 2536, 2537.	Under rock cave, -6 in. tide. <i>Ecklonia</i> zone.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	26/1/1948	V.M. No. 2545.	In shallow, very shaded pool. Tetrasporic.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	25/1/1948	V.M. No. 2553.	Few tetraspores.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	23/3/1948	V.M. No. 2586.	Tetrasporic.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	23/3/1948	V.M. No. 2587, 2588.	
Fairy Bower, Manly, Sydney, N.S.W.	24/3/1948	V.M. No. 2597.	Few tetraspores.

* Herbarium of the North Queensland Naturalists' Club, Cairns, Qsld.

LENOMANDIA CORONATA Lind. and Setch.

New Record for Australia.

Lindauer and Setchell (1946) described and illustrated this species from New Zealand. It is now recorded as occurring in Australia also. The specimens of two of the three collections recorded below are slightly smaller than the New Zealand plants (i.e., Lindauer Alg. N.Z. Exsiccatae No. 74, Herb. NSW and VM).

The Australian specimens were all found growing on rocky ocean headlands and could be collected only at extra low tide. The apices of the "leaves" vary greatly, some being stoloniferous, others mucronate, while others have a depressed growing point surrounded by dichotomous monosiphonous hairs.

Locality.	Date.	Herbarium.	Notes.
Near Sydney, N.S.W.— S.E. Narrabeen Headland.	1/ 7/1946	V.M. No. 2096.	Far out rock pool L.T.L.
Little Beach, Narrabeen.	2S/12/1947	V.M. No. 2515.	Surf-sprayed rock, extra L.T.L. Specimens larger than 2096 or 2552.
" " "	25/1/1948	V.M. No. 2552.	Rock face, extra L.T.L. Tetrasporic.

ACROSORIUM UNCINATUM (J. Ag.) Kylin.

Occurrence of Tetrasporic Material.

A. uncinatum (J. Ag.) Kylin occurs widely distributed, and in Australia is known from our southern and eastern coasts. Generally, however, this species is found in a sterile condition. Kylin (1924), who associated the present binomial name, says he has not seen fertile material of this species. Kuehne (1946) and Nott (1900) regard it as highly likely that *A. uncinatum* reproduces itself largely by vegetative means without spore formation. Lucas (1926, p. 602), speaking of this species in Australia, says: "Though I have examined hundreds of specimens, I have never found cystocarps and only once discovered sori, and then only on one segment of a fairly large plant." He does not give collecting details of this specimen, but in his herbarium the specimen, which is quite large, is clearly marked. He collected it at Sandringham, Botany Bay, N.S.W., in December, 1930.

The only other tetrasporic specimen, other than those quoted below, seen by the writer, was that collected by Harvey (Alg. Aus. Exsicc. No. 298, Herb. NSW), from Port Fairy, Victoria. We do not know whether Harvey collected his specimen from the ocean headland or from the estuarine lagoon at Port Fairy.

The present writer has collected *A. uncinatum* frequently. Most, and largest, specimens have been trawled from estuarine and harbour waters, but none of these has been fertile. Tetrasporic specimens have, however, been obtained several times from ocean headlands, as listed below.

It is suggested, therefore, that ecological conditions affect the production of tetraspores in *A. uncinatum* and that the conditions occurring in sheltered waters favour this process less than do conditions on ocean headlands.

Specimens of *A. UNCINATUM* Bearing Tetrasporic Sori.

Locality.	Date.	Herbarium.	Notes.
Headland opp. Coila Lake, nr. Tuross, Sth. Coast, N.S.W.	30/10/1947	V.M. No. 2493.	Membranes wide, apices more rounded than usual for the species.
Headland between Newport and Bungan, nr. Sydney, N.S.W.	27/12/1947	V.M. No. 2499.	Collected at extra L.T.L.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	25/1/1948	V.M. No. 2551.	Below "browns". Extra L.T.L.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	26/1/1948	V.M. No. 2542.	Extra L.T.L.
Little Beach, Narrabeen, nr. Sydney, N.S.W.	26/1/1948	V.M. No. 2541.	On <i>Amphiroa</i> .
Tathra, N.S.W.	3/1/1943	V.M. No. 2532.	

SUMMARY.

In this paper *Caulerpa anceps* Harv., *Gelidium caulacanthum* J. Ag. and *Lenomandia coronata* Lind. and Setch. are recorded for the first time as collected from Australia, the record of the occurrence here of *Gelidium crinale* is dismissed, while extended geographic ranges within Australia are recorded for *Gelidium pusillum* (Stackh.) Le Jol., *Sarconema filiforme* (Sond.) Kylin, *Gelidiopsis intricata* (Ag.) Vickers, and *Symphocladia marchantioides* (Harv.) Falk. In addition, observations are recorded on *Gelidium australe* J. Ag. and *Gelidium Lucasii* May, and the occurrence of tetrasporic material in *Acrosorium uncinatum* (J. Ag.) Kylin is recorded and discussed.

The new combination is made of *Gelidium pusillum* f. *pseudointricata*, based on *Gelidium pseudointricata* Skottsbl. and Levr.

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